J. Glob. Innov. Agric. Sci., 2021, 9(4):173-181
ISSN (Online): 2788-4546; ISSN (Print):2788-4538
DOI: https://doi.org/10.22194/JGIAS/9.959
http://www.jgiass.com

A SİMULATİON STUDY TO DETERMİNE THE RESPONSE OF MORKARAMAN SHEEP RAİSED İN CENTRAL AND EASTERN ANATOLİAN TO CHANGİNG CLİMATE CONDİTİONS

Ufuk Karadavut[1,*], Burhan Bahadır[2], Volkan Karadavut[3] and Galip Şimşek[4]

[1]Karabuk University, Department of Biostatistic, Campuss of Demir-Çelik, Kılavuzlar-Karabük; [2]Ministry of Agriculture and Forestry, Bingöl Provincial Directorate of Agriculture and Forestry Merkez-Bingöl; [3]Ahi Evran University, Mucur Vocational School, Mucur-Kırşehir; [4]Ahi Evran University, Institute of Science and Technology, Bağbaşı-Kırşehir
*Corresponding author's e-mail: ufukkaradavut@karabuk.edu.tr

Climate change has begun to affect the whole world seriously. If necessary and sufficient measures are not taken, it seems possible that much bigger disasters will occur in the future. The agricultural sector, which forms the basis of food production, is affected the most and rapidly by this change. Significant decreases have been observed in plant and animal production. Our primary purpose is to determine the reproductive potential of animals and the amount of resistance to climate change and evaluate the economic situation. The study was carried out within ten years, covering 2009-2019. In this study, morkaraman sheep bred in the province of Kırşehir in the Central Anatolian Region and the province of Bingöl in the Eastern Anatolia Region is considered material in Turkey. In order to obtain the data used, a total of 296 sheep, 145 sheep in the Eastern Anatolia Region and 151 sheep in the Central Anatolia Region, were evaluated. The simulation study was carried out using the polygenic model. The variables examined are as follows; Lactation time (days), Average daily milk yield (ml), Daily amount of feed consumed for 1 kg live weight (kg), Yield (%), Incidence of Mastitis, Daily oil yield (g/day), Daily protein yield (g/day), Fertility (%), Fertility time (productivity) (Days), Change in milk yield for each degree above 22 °C and Protein change for each degree above 22 °C (g/°C /day).
As a result, in a one-degree increase in temperature, the highest negative effect is seen in the average daily milk yield and lactation period. Fertility and the amount of feed consumed per kg of weight had the lowest value. The preliminary work to be done with the work is that the selection of animals that are resistant/tolerant to climate change should be made.
Keywords: Genotypic effects, climatic change, morkaraman sheep, simulation, sustainability.

INTRODUCTION

The increase in the amount and intensity of the chemicals released into the atmosphere worldwide and called 'greenhouse gases' has started to lead to a point where it is impossible to return environmental events. Greenhouse gases can be found naturally or are released into the air. However, today, the chemicals used to increase industrialization, urbanization and food production and the vast majority of the gases emitted are caused by human activities (Köknaroğlu and Akünal, 2010). When industrial development is examined, no severe threat was seen in environmental pollution until the 1800s. However, with the industrial revolution, the idea of mass production, which includes the desire for more production, has begun to harm nature (Brown *et al.*, 2010). Since the mid-1900s, it is seen that environmental awareness has disappeared rapidly with the ambition to win brought about by the change in the form and content of production (Koyuncu and Akgün, 2018). The 2000s were recorded as the years when environmental disasters manifested themselves (Akram, 2012). Although studies have been started to increase environmental awareness and protect the environment, it is seen that it is not enough.
The world population is increasing rapidly and uncontrollably. The changing world and the constant insensitivity to the environment cause economic and ecological and social and cultural problems. The resulting problems are effective in every sector. However, significant agricultural sectors are much more affected by these negativities. It is known that nearly 3 billion people are engaged in agriculture today (WB, 2018). If the necessary measures are not taken, a significant part of 3 billion people

Karadavut, U., B. Bahadır, V. Karadavut and G. Şimşek. 2021. A Simulation Study to Determine the Response of Morkaraman Sheep Raised in Central and Eastern Anatolian to Changing Climate Conditions. J. Glob. Innov. Agric. Sci. 9:173-181.
[Received 15 Nov 2021; Accepted 13 Oct 2021; Published (online) 30 Dec 2021]

will be able to choose the way of being consumers rather than producers. Agriculture is a core sector that is very active in itself. Agricultural, environmental pollution (especially greenhouse gases such as CO2, CH4 and N2O) is also in question. However, it remains at very low levels compared to the pollution caused by the industry. Pathak and Wassmann (2007) stated that the effect of agricultural activities on greenhouse gas worldwide would not exceed 20% and that the amount of environmental pollution was incomparably low compared to other areas. Naqvi and Sejian (2011) stated that greenhouse gases resulting from agricultural production indirectly affect climate change and that greenhouse gas production from agriculture should be reduced.

It is known that climate change will have an impact on agricultural products. Animal production, which is the most important aspect of agricultural production, will be affected. Serious efforts are being made to prevent this or reduce it as much as possible. However, it seems that this is not enough. It is vital to select animal species and breeds resistant to climate change. It is necessary to develop appropriate breeding strategies and apply them decisively in this context. In order to ensure the continuity of sheep breeding enterprises, which have an important place in terms of livestock, factors such as milk, meat, fleece, increasing their fertility and reducing the incidence of Mastitis in milk should be maintained with appropriate breeding programs (Carabaño *et al.,* 2019). It is expected that the effects of climate change will be felt more prominently and heavily in the coming years. In this, genetic interactions of sheep with the environment should be reduced as much as possible according to the changing climatic conditions (Fuerst-Waltl *et al.,* 2018). Thus, the change will affect production very little. Genetic resistance studies should be prioritized in resistance breeding. Meteorologists are constantly preparing climate change scenarios. Correctional experts should update their programs accordingly. Ramon et al. (2021) stated in their study that a selection weight in the range of 10-20% in goats and sheep would be sufficient for successful selection and that it would also provide an excellent genetic response in terms of both animal production and resistance to changing conditions.

It is expected that climate change will cause an increase in the number of harmful pathogens that will make animals sick, especially in animal reproduction, product quality, a decrease in the general immunity of animals, and a significant decrease in the performance of animals (Collier *et al.,* 2019). Studies to reduce the effects of climate change have generally been aimed at improving environmental animal welfare factors to eliminate the short-term adverse effects. Much attention was paid to increasing the resilience of animals against adverse climatic conditions (Lopes *et al.,* 2012). Due to the inability to develop appropriate breeding and breeding programs. Studies in terms of the effects of climate change generally focused on heat change and continued monitoring of animals' reactions and animal behavior in the face of heat changes (Bernabucci *et al.,* 2014; Carabaño *et al.,* 2014: Freitas *et al.,* 2021). Few studies have examined the effects of temperature change on the genetic structure of animals (Lopes *et al.*, 2012; Brügemann *et al.*, 2013). Evaluation as a whole and breeding programs need to be prepared. In this, a balance must be established between productivity and climatic conditions. If the balance is not achieved, the transactions may fail production and be resistant to changing conditions.

In this study, our primary purpose is to determine the reproductive potential of animals and the amount of resistance to climate change and evaluate the economic situation. Many variables have been evaluated and it has been tried to contribute to the studies to be done by simulating the effects of climate change on animals. The rearing systems of morkaraman sheep raised in Central Anatolia and Eastern Anatolia conditions are emphasized because these two regions are seen as the regions most affected by climate change.

MATERİALS AND METHODS

The study was carried out within ten years, covering 2009-2019. In this study, morkaraman sheep bred in the province of Kırşehir in the Central Anatolian Region and the province of Bingöl in the Eastern Anatolia Region is constituted as material. Morkaraman sheep have adapted to these regions in terms of their structural characteristics. Its solid stance and large structure are among the reasons for preference. Its neck is long and its chest circumference is narrow. However, the leg height is in good condition. Its color can vary from red to purple. Fleece is usually not found on the face and head. While the males are horned, the horns have a large and spiral structure. Females are primarily hornless, but horned ones have very weak horns. They have a fat tail.

Even if the climatic conditions of the Eastern Anatolia Region and the Central Anatolia Region are similar to each other, altitude differences can be determinative of climatic changes. The region has been associated with the existing production systems of morkaraman sheep, which is very important for these regions. Because it is known that changing weather conditions genetically affect the yield status of animals (Sánchez-Molano *et al.,* 2019), it is known to be successful with applying selective breeding methods in these regions. Due to their climatic characteristics, both regions have cold and rainy winters and hot and dry summers (MGM, 2020). Morkaraman sheep have successfully adapted to this change. For the simulation study, it is necessary to determine the performance of the animals first. For this, a simulation study was carried out according to the phenotypic and genotypic values of the resistant characters to changing weather conditions. The features for the scenario to be prepared while performing simulation in Morkaraman sheep are as follows (Sánchez-Molano *et al.,* 2019). The specifications are given as mean ± standard deviation.

The data were obtained from the provincial directorates of agriculture, producer associations operating in the region, and our studies. In order to obtain the data used, a total of 296 sheep, 145 sheep in the Eastern Anatolia Region and 151 sheep in the Central Anatolia Region, were evaluated. The climate data was processed using the records taken from the provincial and regional directorates of Meteorology. Daily, weekly and monthly minimum, maximum and average temperature and humidity values obtained from the measurement stations were used. When using the climate data, the data of the closest announcement station to the animals' location were used. Temperature changes occurring for a short time throughout the study were not considered and excluded from the evaluation because this type of data may cause our estimation to be wrong.

The simulation study was carried out using the polygenic model stated by Falconer (1960). The main reason for doing this is that the inheritance of quantitative characters can be done based on the polygenic model (Kinghorn *et al.*, 1994). Numerous genes with similar frequencies, additive effects and dominance relationships at all loci can affect the studied quantitative characters (Roberts and Smith, 1982; Falconer and Mackay, 1996). Simple linear regression analyzes were used to determine the relationships between the changes in air temperature used in the simulation and the effects of changes in milk and other factors. Genetic correlations between input parameters and traits, including genetic and heritability variance estimates, were made for each trait examined. The environmental deviations observed in the environment for the born offspring were calculated from the multivariate normal distributions for each generation. The determined phenotypic values were obtained by adding the genetic values to the population's environmental deviation and phenotypic mean. An estimated value was calculated for the future, taking into account the reproductive values of the animals. Thus, it was used as a target index with estimated reproductive value. With this index, animals could be ranked and used to select parents that could be used for the next generation. SPSS 21 V statistical program was used during the simulation study.

RESULTS AND DİSCUSSİON

Descriptive statistics of the analyzed variables are shown in Table 1. When the table is examined, it is seen that the highest standard deviation is in the average daily milk yield value for both Bingöl and Kırşehir provinces. This shows that daily milk yield is the most affected by external factors among the variables examined. The contents of the feeds given to the animals, the way they are given and the time they are given affect the average daily milk yield. In general, it is seen that the standard deviation values are high. It suggests that the main reason for this is that sheep are raised under natural conditions rather than special breeder conditions. Under special conditions, it may be possible to change or control the changes in the environment to a certain extent. However, control can be quite difficult or even impossible under natural conditions.

As a result of the study, input parameters including genetic and heritability variance estimates for the studied trait and genetic correlations between traits are given in Table 2. When the table is examined, a positive and significant relationship was observed at the level of 0.01 between the fertility of the lactation period and the protein change for each grade above 22 °C, while it was at the level of 0.05 between the daily feed consumption and the change in milk yield for each grade above 22 °C positive and significant relationships were identified. The daily average milk yield had a significant and positive relationship at the level of 0.01 with the amount of feed consumed daily and the protein and fat changes for each degree above 22 °C. Similarly, significant relationships were determined between the amount of feed consumed daily and the amount of oil and protein produced daily.

The study tried to determine the flexibility and stability structures of animals with simulated data. The obtained

Table 1. Descriptive statistics of the analyzed variables.

Variables	Regions			
	Bingöl (Eastern Turkey)		Kırşehir (Middle Turkey)	
	Means± SD	Min-Max	Means± SD	Min-Max
Lactation time (days)	145,16±12,52	134,22-157,67	143,29±13,10	131,46-162,11
Average daily milk yield (ml)	386,18±29,75	290,64-467,98	393,24±26,16	288,44-421,18
Daily amount of feed consumed for 1 kg live weight (kg)	5,13±7,81	4,89-5,28	5,28±7,66	4,53-5,47
Yield (%)	48,75±4,27	45,08-49,98	45,22±4,83	43,12-50,36
Incidence of mastitis	0,23±0,38	0,14-0,43	0,20±0,34	0,13-0,44
Daily oil yield (g/day)	7,61±4,11	6,96-7,78	6,92±4,89	6,18-8.03
Daily protein yield (g/day)	6,11±2,87	5,87-6,19	6,47±3,17	5,12-6,99
Fertility (%)	0,41±0,38	0,29-0,48	0,39±0,35	0,25-0,46
Fertility time (productivity) (Days)	105,12±5,89	91,56-112,61	110,07±6,15	93,92-116,88
Change in milk yield for each degree above 22 °C	-0,37±0,17	(-0,34)-(-0,38)	-0,33±0,11	(-0,29)-(-0,31)
Protein change for each degree above 22 °C (g/°C /day	-0,26±0,21	(-0,23)-(-0,28)	-0,23±0,25	(-0,21)-(-0,25)

Table 2. Results of correlation analysis between variables.

Değişkenler	LS	GOSV	GYM	R	MI	GYV	GPV	F	FS	SVD	PVD
LS	-	-0.204	-0.439*	0.188	0.094	-0.176	0.277	-0.602**	0.159	0.438*	0.522**
GOSV		-	0.612**	0.276	0.169	0.098	-0.127	0.215	-0.177	0.632**	0.552**
GYM			-	0.056	0.273	0.447*	0.505**	0.302	0.228	0.582*	0.509*
R				-	0.048	0.138	0.205	0.210	0.194	0.093	0.102
MI					-	0.241	0.109	0.115	0.231	0.198	0.207
GYV						-	0.334	0.285	0.361	0.497*	0.534**
GPV							-	0.237	0.169	0.320	0.266
F								-	0.095	0.217	0.316
FS									-	0.079	0.092
SVD										-	0.447*
PVD											-

LS: Lactation time (days), GOSV: Average daily milk yield (ml), GYM: Daily amount of feed consumed for 1 kg live weight (kg), R: Yield (%), MI: Incidence of Mastitis, GYV: Daily oil yield (g/day), GPV: Daily protein yield (g/day), F: Fertility (%), FS: Fertility time (productivity) (Days), SVD: Change in milk yield for each degree above 22 °C, PVD: Protein change for each degree above 22 °C (g/°C /day

stability results are shown in Table 3. When the results obtained are examined, it is understood that the stability characteristics of the examined characters are quite low. It is understood that they are greatly affected by the changing environmental conditions. It is seen that the character with the best stability value is the lactation period for the sheep raised in both regions. While the lactation period was 0.982 for those grown in Bingöl, it had a very high value of 1.02 for those grown in Kırşehir. Changes followed this character in milk and protein yield for each degree above 22 oC in both regions. The lowest stability characteristics were determined in daily oil yields. While the stability value for this feature was 0.115 in Kırşehir province, it was 0.172 in Bingöl province. When the evaluation was made for the stability of all characters, it was seen that the values of both regions were close to each other. Bingöl province, with a value of 0.622, was slightly higher than the province of Kırşehir, which has a value of 0.600, but the difference was not significant.

Changing weather conditions, especially temperature changes, negatively affect milk production's flexibility and stability. As a result of the linear regression study carried out to define the relationship between air temperature and milk, protein and fat yield, it was seen that the relationships were at a very high level. When the regression equations were examined, it was determined that if the temperature increased by one degree, the daily milk yield would decrease by 2.08 ml/day, the oil yield would decrease by 0.96 g/day and the protein yield would decrease by 1.17 g/day. We see that the lactation period will also be significantly affected by the temperature and the lactation period will be shortened by 2.21 days with an increase in temperature by one degree. Yield will decrease by 1.04% and Fertility by 0.34%. Decreases are also expected in the amount of feed consumed by the animal per kg body weight. For each degree increase in temperature, it was determined that the animals would eat 0-14 grams less feed. The linear regression equations and coefficients determined for the variables are as follows;

Table 3. Descriptive stability values of the examined variables.

Variables	Stability values according to regions	
	Bingöl (Eastern Turkey)	Kırşehir (Middle Turkey)
Lactation time (days)	0,982	1,02
Average daily milk yield (ml)	0,617	0,701
Daily amount of feed consumed for 1 kg live weight (kg)	0,739	0,697
Yield (%)	0,307	0,216
Incidence of mastitis	0,298	0,209
Daily oil yield (g/day)	0,172	0,115
Daily protein yield (g/day)	0,588	0,566
Fertility (%)	0,788	0,811
Fertility time (productivity) (Days)	0,467	0,332
Change in milk yield for each degree above 22 °C	0,927	0,966
Protein change for each degree above 22 °C (g/°C /day	0,956	0,972
Average stabilize values	**0,622**	**0,600**

Average daily milk yield = 279,15 – 2,08T
Daily oil yield = 8,12 – 0,96T
Daily protein yield = 6,19 – 1,17T
Lactation time = 138,71 – 2,21T
Daily amount of feed consumed for 1 kg live weight = 4,97 – 0,14T
Yield = 42,80 – 1,04T
Fertility = 0,39 – 0.034T

Ataman (1997) stated that stress factors negatively affect the reproductive and vitality period in animals, while he stated that temperature is one of the most important factors. Garcia-Ispierto et al. (2006) stated that temperature triggers all kinds of adverse changes in animals. They also stated that short-term temperature changes do not have a significant effect, but long-term changes will cause severe reductions in yield and quality. Colak and Shepherd (2002) reported similar results. Because heat stress causes the deterioration of the diet, hormonal balance, and insufficient development of the embryos (Topuzoğlu and Baştan, 2010). Especially in the case of prolonged heat stress, the amount of possible disease in animals increases, the mortality rate increases, growth and development retardations are experienced, and the quantity and quality of all products, especially milk yield, decreases (Wolfenson *et al.*, 2000; Nandi *et al.*, 2001). In their study, Peralta et al. (2005) stated that pregnancy rates that occur under normal conditions with an increase in temperature are as low as 80%. Accordingly, it is estimated that decreases in fertility and fertile duration will increase in the future with the effect of temperature. The simulation results obtained in the study confirmed the statements of the researchers.

Nardone et al. (2002) stated that the yield losses might be beyond the expected due to climate change and especially the adaptation ability of the animals to the rapid changes due to warming. Again, Nardone et al. (2010) stated that due to global warming, there is a significant decrease in milk yield in dairy cattle and live weights in beef cattle. Petrovica et al. (2015), on the other hand, showed that the number of animal bugs and pests increased due to the change caused by global warming, and therefore, their losses in yield increased. The results we obtained in our study agree with the researchers' results. It is stated that the temperature in Turkey has increased by 1-1.5 degrees compared to the last 100 years (MGM, 2020). It is expected that the temperature will increase further in the coming periods. One of the environmental stimulants, significantly the increase in temperature, can directly affect the hormones that affect the target tissues in animals. Accordingly, it can cause a decrease in feed consumption, acceleration of respiration, and increased water consumption (Koyuncu and Akgün, 2018).

In the study, 25 replications were made for each breeding scenario, and their reliability was checked. 30% male and 50% female, which are in the best condition for each generation, were selected from the animals constituting the central mass. The simulation study determined the maximum number of offspring per sire and dam as 7% (Romon *et al.*, 2021). Inbreeding depression, especially in inbreeding, was evaluated as linearly related to inbreeding, and accordingly, inbreeding was negatively affected fertility. Crow, J.F., Dennistan (1988) stated that the size of the variance of the population is influenced by the rearing of the hind-breed and in this, it is necessary to be careful in inbreeding. In addition, Ertuğrul et al. (2005) emphasized in their study that inbreeding should be continued in a controlled manner in order to protect gene resources. Özcan et al. (2004), on the other hand, stated that some environmental factors might have a more significant effect on growth and development in sheep. It is known that continuous inbreeding can be inconvenient and decrease yield and quality. Genotypic renewal is recommended from time to time for this purpose (Nandagawali *et al.*, 1996; Cassel *et al.*, 2003). Our study believed that genetic innovation should be made after ten years of inbreeding.

In the scenarios prepared for breeding, an evaluation was made on the sum of the gains obtained for each trait and

Table 4. The evaluation made by weighting the analyzed variables with their economic value.

Variables	**Economic Losses by Regions (Dollar/Day)**	
	Bingöl (Eastern Turkey)	**Kırşehir (Middle Turkey)**
Lactation time (days)	4	4,5
Average daily milk yield (ml)	1,8	2,1
Daily amount of feed consumed for 1 kg live weight (kg)	2,1	2,9
Yield (%)	3,6	4,2
Incidence of mastitis	11,8	12,8
Daily oil yield (g/day)	1,4	1,3
Daily protein yield (g/day)	1,2	1,2
Fertility (%)	5,1	6,3
Fertility time (productivity) (Days)	4,7	5,1
Change in milk yield for each degree above 22 °C	0,03	0,03
Protein change for each degree above 22 °C (g/°C /day	0,02	0,03
Avreage economic losses	**3,25**	**3,68**

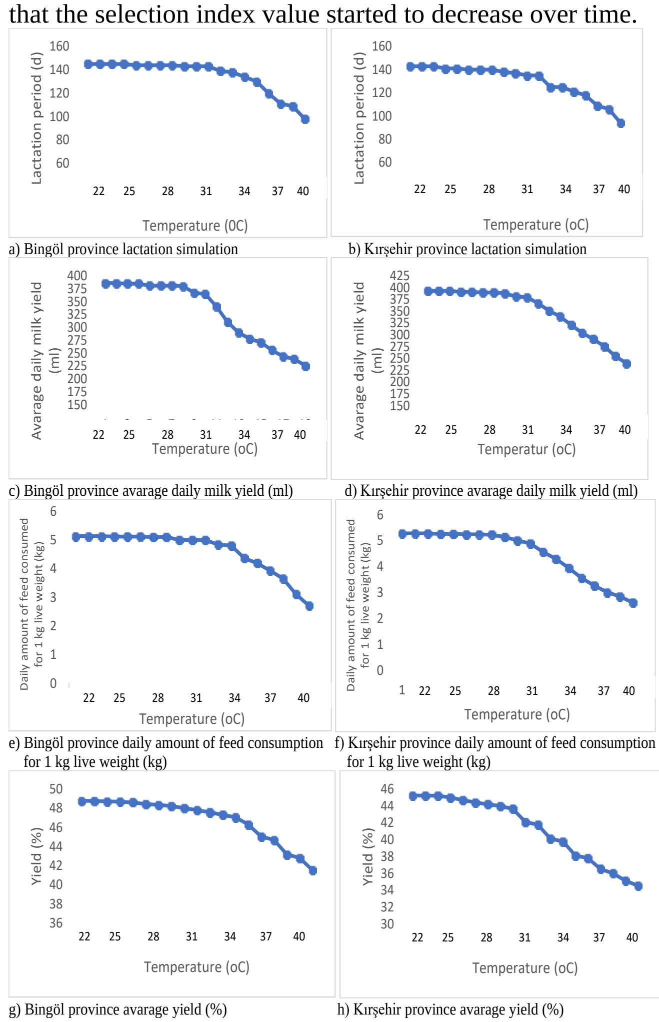
weighted with the economic value. The evaluations made are given in Table 4. When the table is examined, it is seen that Kırşehir province will be affected more economically by climate change. The highest loss was observed in the incidence of Mastitis. The loss, which was 118 TL in Bingöl, was determined as 128 TL in Kırşehir.With this study, attention was paid to this in the simulation study since it was to determine the resistance point that the animals would show against temperature increase by taking reference breeding techniques in morkaraman sheep as reference.

Mutluer (2001) stated in his study that the rate of Mastitis is around 35% in dairy cattle throughout Turkey. However, the rate of Mastitis in sheep is around 11% and most of them (95%) are subclinical. The remaining part has clinical features (Baysal and Edge, 1989). It is known that an increase in mastitis rate negatively affects milk yield and quality. The most important factors causing Mastitis in sheep are *Pasteurella mastitis, Pasteurella multocida, Pasteurella haerp.olytica, Staphylococcus aureus, Staphylococcus epidermitis, Corynebacterium pyogenes, Corynebaoterium ovis, E. coli, Mycoplasma spp. and Anthrocoids* (Erdoğan and Batu, 1980; Batu and Fırat, 1981). In general, mastitis studies are carried out for dairy cattle in Turkey. Very few studies have been done on sheep. It is necessary to carry out such studies in the area where the study is carried out and throughout Turkey.

The lowest amount of loss was found in milk and protein yield changes (g/oC/day) for each degree above 22 oC. It is known that temperatures above 22 degrees adversely affect animal welfare at specific rates. However, it has been observed that it does not seriously affect up to 32 degrees. After this degree, every increase in temperature caused an increase in stress conditions in animals. Increasing stress conditions constitute the beginning of the change in all characteristics of animals, especially milk yield. The fact that animals have been genetically adapted to the region and have been bred for many years causes the limits of tolerance to expand genetically. However, it is understood that it will not be possible for the tolerance to short-term temperature changes to show itself under long-term high temperatures. For this reason, it would be beneficial to prioritize studies that can reduce heat stress in breeding studies.

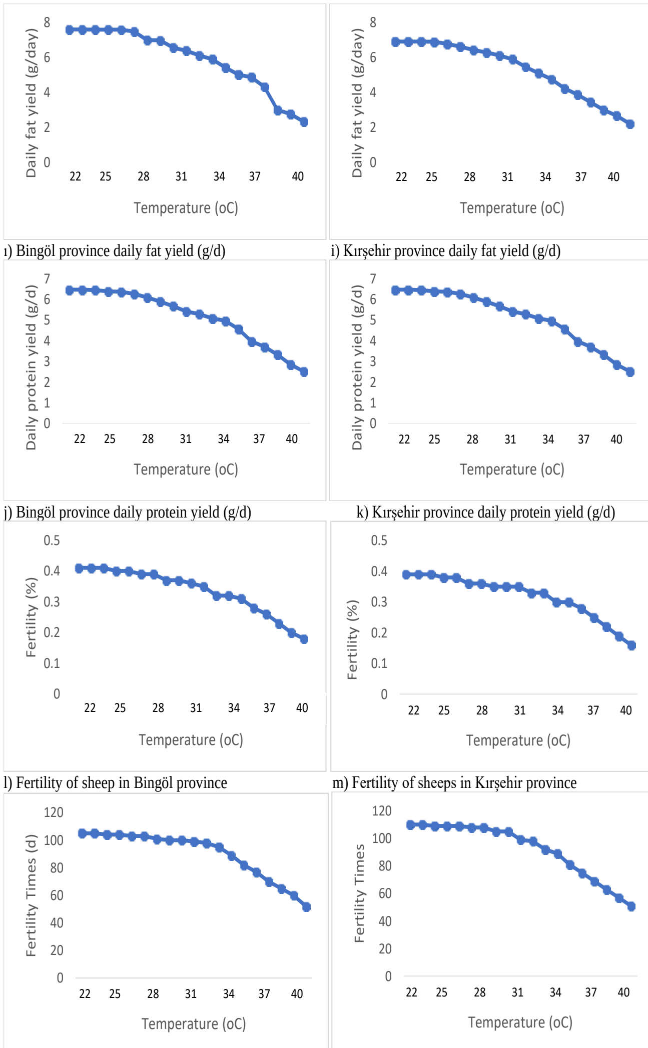
The graphical representation of the simulation results for the characters examined in the study is shown in Figure 1. When the figures were examined, the increase in temperature caused a decrease for all characters. Especially staying above 30 degrees for a long time increases the heat stress and ends the efficiency-quality relationship. Changes in the provinces of Bingöl and Kırşehir, the study areas, take values close to each other. However, the changes observed in Kırşehir province are slightly faster and more severe than the changes in Bingöl province. While Bingöl province is 1925 m above sea level, Kırşehir is 975 m. However, the difference observed is that beyond the height, Kırşehir is located in a flat area, and Bingöl is located in a depression between the mountains. This geographical difference may have caused the change in Kırşehir province to be very fast. The effects of temperature are felt much more in Kırşehir province due to its geographical location.

In the study, in the evaluation of the sheep according to the regions, the weather conditions in both regions appear as the subject that should be dealt with as a priority. It is understood that the increase in temperature will continue to increase in the coming years. Accordingly, preparations must be made in advance to take the necessary measures. Even if there are some minor changes in the breeding of sheep, a more positive trend for milk yield was observed in the scenarios made for breeding animals compared to other characters. The incidence of Mastitis also decreased as the effects of weather conditions were reduced. Air temperature will increase the incidence of Mastitis a little more. This is seen as the prolongation of the duration of stay in the pasture. In the study, it was observed that the selection index value started to decrease over time.



a) Bingöl province lactation simulation
b) Kırşehir province lactation simulation
c) Bingöl province avarage daily milk yield (ml)
d) Kırşehir province avarage daily milk yield (ml)
e) Bingöl province daily amount of feed consumption for 1 kg live weight (kg)
f) Kırşehir province daily amount of feed consumption for 1 kg live weight (kg)
g) Bingöl province avarage yield (%)
h) Kırşehir province avarage yield (%)

Figure 1. Simulation results for the provinces of Bingöl and Kırşehir according to the investigated characters.



ı) Bingöl province daily fat yield (g/d) i) Kırşehir province daily fat yield (g/d)

j) Bingöl province daily protein yield (g/d) k) Kırşehir province daily protein yield (g/d)

l) Fertility of sheep in Bingöl province m) Fertility of sheeps in Kırşehir province

n) Fertility times of sheep in Bingöl province o) Fertility times of sheep in Kırşehir province

Figure 2. Simulation results for the provinces of Bingöl and Kırşehir according to the investigated characters (Continued).

This was thought to be related to the increase in temperature. It was observed that there was a general decrease of 18-28% between the period when the study was started and the end period. The results started to show positive changes by increasing the selection weight given for their resistance to temperature change in sheep. While this change was -2.68 before, it decreased to -1.66 g/°C/day with an emphasis on durability.

This study has also aimed to direct the tendency towards different areas, especially economically, on sheep breeding, which has a very important place for our future. Because it is necessary to increase the tolerance of the animals against the negative changes that will occur due to the increase in temperature for this, it is necessary to prepare for the future by doing the necessary work before it is too late.

Sheep have great economic importance for climatic conditions in both regions (Bingöl and Kırşehir) studied. However, when the production and breeding strategies are taken into account in the studies that have been done and will be carried out, sudden changes in temperature and weather events may force the economic and healthy activities of the studies. Even small changes in production quantity and quality mean large-scale losses. The consequences of large-scale losses can be truly devastating. We need to correctly understand the relationships between the production levels of animals, their capacity and endurance characteristics and develop a strategy accordingly. It is necessary to make the necessary selections for heat resistance based on genetics and ensure genetic progress.

It is necessary to improve the amount of fat and protein production and the time of giving them, especially the milk yield of the sheep. The stability of growth and development of animals is not sufficient for resistance to changing weather conditions. At the same time, the productivity of animals must be stable because we need to consider the animal as a whole. An important part of the animals living in Bingöl province is located in Karlıova district. The altitude of this district is about 2000 meters. Temperature changes here are much more minor and limited compared to Kırşehir province. However, Kırşehir province is affected by temperature changes at a much higher rate. This is more clearly understood in the study when the reduction amounts and speeds in the province of Kırşehir are taken into account. In order for the production scenarios to be implemented, the minor possible error should be allowed to occur. However, sudden changes in the air branches caused by the possible problems, difficulties and temperature changes due to the temperature increase constitute a critical constraint for the studies to be carried out. In order to prevent this, it will be necessary to use more stable breeding and distinctive scales according to the regions and to reduce the tolerance limits to be made within this. Reducing the tolerance limits will help us to prevent possible changes in advance.

Fertility of animals raised in Bingöl province is much better than Kırşehir province. However, it will not be enough to work on the fertility rate. Along with preserving fertility, the quantity and quality of milk will also need to be maintained. In general, it is necessary to control the decrease observed in the amount and duration of vitality as the temperature increases in the reproduction of animals due to weather conditions. In the study, it is thought that the temperatures will increase between 2-2.5 degrees in the next twenty years. While this increase will cause the winters to be much milder, it will cause the summer months to be much hotter. Especially in the province of Kırşehir, where the summer months last as long as 4-5 months, and in the province of Bingöl, which lasts 3-4 months, the adverse effects on animals should be expected increase even more. The deterioration of the existing endurance characteristics of animals due to temperature

changes should be well studied. This deterioration may be caused by temperature increase as well as other factors. If we can identify the factors that negatively affect resilience, we can better manage resilience and sustainability in animal yields. The study observed that the correlations between endurance and other characteristics were not statistically significant. However, the fact that they have received positive values suggests that they can be interfered with their certain degree of flexibility and contribute to the sustainability of efficiency and productivity. Of course, it should be known that the effects of genetic improvements on animals will be significant.

In advance, it is specified how much importance will be given to which character in simulation studies. Evaluation is made accordingly. Our study made numerous evaluations, and the best results were obtained with a 25% emphasis on durability. If the effect of weather conditions is taken at 15% or less, the durability increases, but if it is above this, it decreases depending on the increase in temperature. The most appropriate effect rate was determined as 10%. However, we cannot expect this ratio always to yield positive results because the realized values are more important to us. With the increase in temperature, not only decreases in reproductive power and quantity but also in quality, increase in diseases and perhaps the emergence of new types of diseases. Of course, these are seen as factors that reduce economic efficiency from an economic point of view. Each negative impact will also directly impact the endurance studies and their economic values.

This study is only a 10-year study and it needs to be emphasized and continued by adding new studies. According to the results obtained in the coming years, it will be possible to make healthier evaluations. For this reason, it will be necessary to make continuous updates in the economic evaluation of the work done and to be done.

***Conclusion*:** As a result, the study was carried out on morkaraman sheep in two regions with very different climatic and geographical conditions. In order to ensure sustainability against temperature increase, it is necessary to develop rational breeding strategies, determine the variables to be used well, and keep the amount of performance losses of animals at the lowest level possible. In this regard, it is necessary to continue the breeding work with zero tolerance, if possible. This study will contribute to the work with this match and will be a guide.

Authors' Contributions Statement and Conflict interest: All authors contributed to the study to a certain extent. There is no conflict of interest among the researchers.

***Acknowledgment*:** We would like to thank the Bingöl and Kırşehir Provincial Directorate of Agriculture and Forestry, the Sheep Goat Breeders' Association and animal producers and breeders for helping us in this study.

REFERENCES

Akram N. 2012. Is Climate Change Hindering Economic Growth of Asian Economies ?", Asia-Pac. Dev. J.19:1-18.

Ataman M.B. and K. Çoyan. 1997. Stres'in reprodüktif olaylar üzerine etkisi. Y. Y. Ü. Vet. Fak. Derg. 8:118-121.

Batu, A. and G. Fırat. 1980. Trakya ve Marmara bölgesinde koyunlarda klinik ve subklinik mastitisler ve etkenleri üzerine araştırma, Pendik Vet. Mikr. Enst. Derg.1981, C. XIII, S. 1:11·21.

Bernabucci, U., S. Biffani, L. Buggiotti, A. Vitali, N. Lacetera, N., and A. Nardone. 2014. The effects of heat stress in Italian Holstein dairy cattle. J. Dairy Sci. 97:471-486.

Brown, C., R. Meeks, Y. Ghile and K. Hunu. 2010. An Empirical Analysis of the Effects of Climate Variables on National Level Economic Growth", World Bank's World Development Report 2010: Policy Research, Working Paper No: 5357:1-27.

Brügemann, K., E. Gernand, U.U. Borstel and S. König.2013. Application of random regression models to infer the genetic background and phenotypic trajectory of binary conception rate by alterations of temperature humidity indices. Livest. Sci. 157:389-396.

Carabaño, M. J., K. Bachagha, M. Ramon and C. Diaz. 2014. Modeling heat stress effect on Holstein cows under hot and dry conditions: selection tools. J. Dairy Sci. 97:7889-7904.

Carabaño, M. J., M. Ramon, A. Menendez-Buxadera, A. Molina and C. Diaz.2019. Selecting for heat tolerance. Anim. Front. 9:62-68.

Cassell, B.G., V. Adamec and R.E. Pearson. 2003. Effect of incomplete pedigrees on estimates of inbreeeding and inbreeeding depression for days to first service and summit milk yield in Holstein and Jerseys. Journal of Dairy Sci. 86:2967-2976.

Collier, R.J., L.H. Baumgard, R.B. Zimbelman and Y. Xiao. 2019. Isı stresi: iklimlendirme ve adaptasyon fizyolojisi. *Animation Ön.* 9:12-19.

Crow, J.F. and C. Dennistan. 1988. Inbreeding and Variance Effective Population Numbers, Evaluation. 42:482-95.

Çolak, A. and N.S. Çoban. 2002. Isı stresinin fertilite ve embriyonik ölümler üzerine etkisi. Bültendif. 18:6-8.

Erdoğan, İ. and A. Batu. 1980. Keçi mastitislerinin teşhisinde CMT ve bakteriyolojik yoklamalar ile somatik hücre sayimı yöntemlerinin karşılaştırılması üzerine araştırma. Pendik Vet. Mikrobiyoloji Enst. Dergisi, Cilt XII. Sayı . 2:5-1.7.

Ertuğrul, M., G. Dellal, C. Elmacı, O. Akın, O. Karaca, T. Altın and İ. Cemal. 2005. Hayvansal gen Kaynaklarının Koruma ve Kullanımı. TMMOB Ziraat Mühendisleri Odası, Teknik Kongre. 707:3-7.

Falconer, D. S. 1960. Introduction to Quantitative Genetics. Edinburgh and London. Oliver and Boyd. pp. 365.

Falconer, D.S. and T.F.C. Mackay, 1996. Introduction to Quantitative Genetics. 4th edn., Longman Group Ltd, UK.

Freitas, P. H. F., Y. Wang, P. Yan, H.R. Oliveira, F.S. Schenkel and Y. Zhang. 2021. Genetic diversity and dignatures of selection for thermal stress in cattle and other two bos species adapted to divergent climatic conditions. Front. Genet. 12:604823.

Fuerst-Waltl, B., B. Lang and C Fuerst. 2018. Economic values for a total merit index of dairy goats in Austria. Die Bodenkultur J. Land Manag. Food Environ. 69:97-104.

Garcia-Ispierto, I., F. Lopez-Gatius, P. Santolaria, J.L. Yaniz, C. Nogareda M. Lopez-Bejar and F. De Rensis. 2006. Relationship between heat stress during the peri-implantation period and early fetal loss in dairy cattle. Theriogenology. 65:799-807.

Kinghorn, B.P., J.A.M. van Arendonk and D.J.S. Hetzel. 1994. Detection and use of major genes in animal breeding. AgBiotech News and Information. 6:297-302.

Koyuncu, M. and H. Akfün. 2018. Çiftlik Hayvanları ve Küresel İklim Değişikliği Arasındaki Etkileşim. Journal of Agricultural Faculty of Uludag University. 32:151-164.

Köknaroglu H. and T. Akünal. 2010. Küresel Isınmada Hayvancılığın Payı ve Zooteknist Olarak Bizim Rolümüz, SDÜ. Zir. Fak. Derg. 5:67-75.

Lopes, F. B., A.R. Borjas, M.C. da Silva, O. Facó, R.N. Lôbo and M.C.S. Fiorvanti. 2012. Breeding goals and selection criteria for intensive and semi-intensive dairy goat system in Brazil. Small Rum. Res. 106:110-117.

MGM, 2020. Tarım ve Orman Bakanlığı Meteoroloji Genel Müdürlüğü Kayıtları, Ankara.

Mutluer, B., 2001. Süt İnekçiliğinde Mastitis Sempozyumu, 04-05 Mayıs, Burdur, Akd. Üni. Vet. Fak. Yayın Ünitesi, yayın . 2:1.

Nandagawali, S.B., M.D. Kothekar, A.K. Gore and S.N. Deshmukh. 1996. Effect of non-genetic factors and inbreeding on reproduction and production traits in Sahiwal. Indıan. Vet. J. 73:159-163.

Nandi, S., M.S. Chauhan and P. Palta. 2001. Effect of environmental temperature on quality and developmental competence in vitro of buffalo oocytes. Veterinary Record.148: 278-279.

Naqvi, S.M.K., V. Sejian. 2011. Global Climate Change: Role of Livestock, Asian J. of Agric. Sci. 3:19-25.

Nardone A., B. Ronchi, N. Lacetera, M.S. Ranieri and U. Bernabucci. 2010. Effects of Climate Changes on Animal Production and Sustainability of Livestock Systems, Livestock Science, Sy. pp. 57-69.

Nardone, A. 2002. Evolution of Livestock Production and Quality of Animal Products. Proc. 39th Annual Meeting of the Brazilian Society of Animal Science Brazil, 29th July-2nd August, pp. 486-513.

Özcan, M., B. Ekiz, A. Yılmaz and A. Ceyhan. 2004. The effects of some environmental factors afecting on the growth and greasy fleece yield at first shearing of Turkish Merino (Karacbey Merino) lambs. İst. Üniv. Vet. Fak. Derg. 30:159-167.

Pathak, H. and R. Wassmann. 2007. Introducing Greenhouse Gas Mitigation as A Development Objective in Rice-Based Agriculture: I. Generation of Technical Coefficients, Agric. Syst. 94:807-825

Peralta, O.A., R.E. Pearson and R.L Nebel. 2005. Comparison of three estrus detection systems during summer in a large commercial dairy herd. Anim. Reprod. Sci. 88:155-167

Ramón, M., M.J. Carabaño, C. Díaz, V.V. Kapsona, G. Banos and E. Sánchez-Molano 2021. Breeding Strategies for Weather Resilience in Small Ruminants in Atlantic and Mediterranean Climates. Front. Genet. 12:1-11.

Roberts, R.C. and C. Smith, 1982. Genes with large effectstheoretical aspects in livestock breeding. Proc. 2nd World Congr. Genet. Appl. Livest. Prod., 4-8 October 1982. Madrid. 6:420-438.

Topuzoğlu, B. And A. Baştan. 2010. Sütçü İneklerde Isı Stresinin Döl Verimi Üzerine Etkisi. Vet Hek. Der Derg. 81:29-32.

WB (The World Bank), 2018. Dip Dalgası Raporu (Groundswell). https://www.worldbank.org/(ET: 21.06.2020).

Wolfenson, D., Z. Roth and R. Meidan. 2000. Impaired reproduction in heat-stressed cattle: basic and applied aspects. Anim. Reprod. Sci. 60:535–547.